

New Uses for Sugar Beet Pulp

More than 1 million tons of sugar beet pulp are generated annually by U.S. beet sugar industries. Finding profitable uses for the biodegradable pulp, which is the leftover residue from sugar extraction, is critical for the long-term economic viability of U.S. agribusiness.

Agricultural Research Service researchers and colleagues have long been studying the potential of sugar beet pulp utilization. Now, chemist LinShu Liu and plant physiologist Arland Hotchkiss, both with the Dairy and Functional Foods Unit at ARS's Eastern Regional Research Center in Wyndmoor, Pennsylvania, and colleagues have found new uses for sugar beet pulp.

In collaboration with professor Jinwen Zhang of Washington State University (WSU) in Pullman, Liu and ARS-WSU colleagues developed a biodegradable thermoplastic (meaning plastic that becomes soft when heated) that could be used in disposable food containers.

The bioplastic is manufactured from both sugar beet pulp and a biodegradable polymer called polylactic acid, or PLA, using a twin screw extruder. PLA is a commercially available polymer derived from the sugars in corn, sugar beet, sugarcane, switchgrass and other plants—renewable feedstocks. Extrusion is a cost-effective manufacturing process that is popularly used in large-scale production of food, plastics, and composite materials. Many biopolymers and their composite materials with petroleum-based polymers also can be extruded.

The scientists showed that up to 50 percent sugar beet pulp can be incorporated with PLA, and the resulting thermoplastic composites retain mechanical properties similar to those of polystyrene and polypropylene—the compounds used to make white, spongy food packages. The new thermoplastic is cost competitive with commonly used petrochemical plastics. The study was published in *Industrial & Engineering Chemistry Research* in 2008.

ARS-WSU researchers also developed other sugar beet pulp materials. Under extrusion compounding, sugar beet pulp was turned into a thermoplastic-like material with the assistance of water and/or glycerol. This material can be subsequently processed by extrusion or injection molding to produce neat (meaning pure) sugar beet pulp products.

The resulting thermoplastic sugar beet pulp possesses mechanical properties that are similar to those of low-density polyethylene—the commonly produced materials used for opaque plastic containers, bags, and film coverings. It can also be blended with PLA and other biodegradable polymers for enhanced water resistance. The composite could function as a lightweight-bearing material comprising up to 98 percent sugar beet pulp.

This continued development of the sugar beet pulp plastic—for example as yogurt cups, cottage cheese tubs, or other thin, opaque plastic containers—could benefit sugar beet growers and beet sugar processors. More findings were reported in the *Journal of Polymers and the Environment and Industrial & Engineering Chemistry Research* in 2011.

The new composite plastics containing sugar beet pulp are cost competitive when compared to materials

that are made solely of PLA, according to Liu and Hotchkiss. “The technology is promising and provides a ‘green’ material for food packaging,” says Hotchkiss.—By **Rosalie Marion Bliss, ARS.**

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Plant physiologist Arland Hotchkiss (right) adds sugar beet pulp and polylactic acid to an extruder to make the bioplastic strips that chemist LinShu Liu is inspecting.